**Indicators**

Some students are discussing indicators.

**Tyler:** An indicator tells you whether a solution is an acid or alkali.

**Jahan:** An indicator releases a red colour from acids (and blue from alkalis).

**Leroy:** Different indicators change colour at different pH levels.

**Paul:** Indicators make an acid react with an alkali.

1. Who do you agree with, and why?

|  |  |
| --- | --- |
| Cards for  **Indicators** |  |
| **Tyler:** An indicator tells you whether a solution is an acid or alkali. | **Jahan:** An indicator releases a red colour from acids (and blue from alkalis) |
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*Chemistry > Big idea CSU: Substances and properties > Topic CSU3: Acids and alkalis > Key concept CSU3.1: pH scale*

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| **Diagnostic question** |
| **Indicators** |

**Overview**

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| Learning focus: | Acidic and alkaline solutions may be compared using the pH scale. |
| Observable learning outcome: | Describe what information an indicator provides. |
| Question type: | talking heads |
| Key words: | indicator, acid, alkali, pH |

**What does the research say?**

Research (Nakhleh and Krajcik, 1994) found that students have a range of misunderstandings relating to colour. For example, some though that acids and bases have their own particular colour and others that acids are coloured red and bases are coloured blue.

Another paper (Demircioğlu et al., 2005) describes a misunderstanding that indicators help with neutralisation. This may be a misinterpretation of experimental observations.

Sheppard (2006) undertook research into high school students’ understanding of titration and acid-base phenomena related to this. Of the students who took part in this small study, all thought that the indicator would change colour at pH 7. This may be due to students’ initial introduction to indicators being through the use of litmus to distinguish acids and alkalis.

Nakhleh and Krajcik (1994) recommend ‘prelab discussion’ to focus students attention on what to observe and to make the objectives of the experiment clear as well as ‘post-lab’ discussion to uncover and confront any alternative conceptions that may arise during the course of the experiment.

**Ways to use this question**

This task is intended for discussion in pairs or small groups. It can be done as a pencil and paper exercise or projected onto a screen.

Students should read the statements and follow the instructions on either the worksheet or the PowerPoint. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions may be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as the scribe. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

NB in any class, small group discussions typically improve over time and a persistence with this strategy is often very successful in the medium to long term.

**Expected answers**

Litmus and universal indicator do tell you whether a solution is acid or alkali, so Tyler is partly right however other indicators change colour at other values of pH, so Leroy’s answer applies more generally.

**How to respond - what next?**

A student who thinks that an indicator makes an acid react with an alkali may have misinterpreted an experiment in which indictor was added to show the change of pH in a neutralisation reaction. Understanding of salt formation through neutralisation is explored in key concept 4.1: Making salts.

A student who agrees that an indicator releases a red colour from an acid (and blue from alkalis) may benefit from the use of litmus or universal indicator paper rather than liquid so that the acid or alkali remains obviously colourless.

If students have misunderstandings about indicators always being able to distinguish an acid from an alkali may benefit from being introduced to a wider range of indicators.

CLEAPSS have produced instructions for a microscale chemistry practical which shows the colour of a variety of indicators at different pH. CLEAPSS members may download guidance from <http://science.cleapss.org.uk/Resource-Info/PP057-Making-a-Universal-Indicator-A-Microscale-Approach.aspx>

**Acknowledgments**

Developed by Helen Harden (UYSEG).

Images: None

**References**

Demircioğlu, G. A., Alipaşa and Demircioğlu, H. (2005). Conceptual change achieved through new teaching program on acids and bases. *Chemistry Education Research and Practice,* 6(1)**,** 36-51.

Nakhleh, M. B. and Krajcik, J. S. (1994). Influence of levels of information as presented by different technologies on students' understanding of acid, base and pH concepts. *Journal of Research in Science Teaching,* 31(10)**,** 1077-1096.

Sheppard, K. (2006). High school students' understanding of titrations and related acid-base phenomena. *Chemistry Education Research and Practice,* 7(1)**,** 32-45.